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INFORMAL ALLIANCES:
INFORMATION TRADING BETWEEN FIRMS

Stephan Schrader

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SUMMARY

Firms frequently cooperate by exchanging valuable information informally. This paper presents empirical evidence on information trading in the U.S. specialty steel and steel mini-mill industry. Technical information is exchanged informally between firms, including direct competitors. Employees who trade information orient their trading decisions around the economic interests of their firms. Employees are less inclined to provide information if doing so is likely to considerably hurt their firm's ability to capture economic rents from the information. They are more willing to provide information if they can expect to receive valuable information in return. Factors like friendship or duration of the relationship with the inquirer appear to be of secondary importance for the decision whether to trade a specific unit of information.

The paper also shows that employees simplify the complexity of trading decisions by considering only a selected set of variables, especially the importance of the information to the employee's firm and the degree of competition between the involved firms. Three types of decision makers can be identified in the context of information trading: value-oriented, competition-oriented, and complex decision makers.

Many circumstances are conceivable under which an information exchange is in the economic interest of the involved firms, yet under which detailed formal transfer agreements are ruled out because they are too expensive. Firms that do not use informal information trading for acquiring information under such circumstances may sacrifice an important information source.

CONTENT

INTRODUCTION

Alliances and inter-firm networks have received considerable attention in recent years. Firms are encouraged to enter long-term relationships, to form strategic alliances, and to engage in "cooperative competition" (Balakrishnan & Koza, 1990). Most investigators of these phenomena concentrate on formal cooperation mechanisms such as joint ventures and R&D consortia. This chapter, however, explores one widely neglected component of inter-firm cooperation: informal information trading.[1]

Information trading refers to the exchange of information for information across firm boundaries (von Hippel, 1987; Schrader, 1991). Employees provide

information to colleagues in other firms, including directly competing firms, in the expectation of receiving valuable information in return. Informal information trading may occur without any formal contract to set the stage. Also observed in the context of formal inter-firm agreements, it constitutes a crucial element of the actual implementation of such agreements. Hamel, Doz, and Prahalad (1989: 136) observe: "Top management puts together strategic alliances and sets the legal parameters for exchange. But what actually gets traded is determined by day-to-day interactions of engineers, marketers, and product developers."

Several studies have demonstrated the importance of informal communication networks for technical problem solving (e.g., Allen, 1984; Bradbury, Jervis, Johnston, & Pearson, 1978; Czepiel, 1974). Analyzing information transfer in the semiconductor industry, Rogers (1982: 115-116) concludes that although formal, official channels exist for the exchange of technical information, "the most valuable information is communicated via informal channels."

How do employees decide when to trade information informally with a colleague in another firm? This chapter discusses the results of two studies on the informal exchange of technical information in the U.S. specialty steel and steel mini-mill industry. The studies demonstrate, first, that employees attempt to trade information based on the economic interests of their respective firms and, second, that heuristics are employed to simplify the complexity of information-trading decisions. Finally, the chapter discusses the relationship between informal information trading and other, more formalized inter-firm alliances.

A CHARACTERIZATION OF INFORMATION TRADING

Many opportunities are available for information to be exchanged informally. Employees are in contact with colleagues at conferences and meetings of industry

associations; joint ventures require close cooperation between employees from different firms; equipment suppliers introduce engineers to their counterparts at other firms. These opportunities frequently provide the framework for an informal, fast, and need-oriented exchange of information.

To illustrate the information-trading process and some of its advantages, consider the case of a medium-sized steel mini-mill in which a new continuous caster was installed. (A continuous caster is used to cast liquid steel into semifinished products, such as billets, which are transformed by later processing steps into mill products, such as bars and wires.) Unforeseen technical difficulties in the start-up process were encountered. The superintendent responsible activated his network of personal contacts by calling up a colleague who worked for a directly competing firm. The colleague, whose firm was using the same piece of equipment, had to decide whether to provide the information requested. In this case, he provided the needed help, and the technical problem was solved swiftly. (If he had thought that providing the information would create a disadvantage for his firm, he probably would have refused the request.) The superintendent who received the help knew that he was incurring an obligation to provide similar assistance in the future. Reciprocity appears to be one of the fundamental rules governing information trading.

Such informal transfer of technical information between firms is observed frequently (e.g., Martilla, 1971). Allen (1984) shows that personal contacts with colleagues working in other firms are of considerable importance to the performance of technical development projects (see also Katz & Tushman, 1981). In a study of the diffusion of a major technical innovation, Czepiel (1974: 178) observes the existence of "a functioning informal community linking together the firms" based on word-of-mouth communication.

These observations are confirmed by my investigation of informal information trading in the U.S. specialty steel and mini-mill industry. Surveyed middle-level managers and engineers were asked to indicate the importance of colleagues in other steel firms as a source of technical information. Sixty-one percent of 294 respondents considered colleagues in other firms to be an important or even very important information source, i.e., they indicated a value of at least 5 on a 7-point scale, with 1 meaning "not at all important" and 7 meaning "very important" (Figure 1).

Insert Figure 1 about here

In comparison with other possible information sources (colleagues within the same firm, vendors, customers, professional journals and books, and presentations at conferences), only colleagues within the same firm are considered, on average, to constitute a significantly more important information source than colleagues at other firms.

External contacts are not only an important information source for the employees surveyed; these employees themselves are sought after as information providers. Eighty-five percent reported that, at least once during the year before the survey, they had been asked by a colleague working in another firm for some specific technical information. Nineteen percent had been asked 10 or more times. Of all the employees who had been sought after as an information source by their colleagues, only 2 percent had never provided the desired information. Altogether, 83 percent of the employees surveyed had provided information at least once during the period of investigation to colleagues in other steel firms.

INFORMATION TRADING IN THE U.S. SPECIALTY STEEL AND STEEL MINI-MILL INDUSTRY: THE GENERAL PATTERN

Little is known about employees' decisions about whether to provide a colleague from another firm with technical information. Von Hippel (1987) proposes that information trading can benefit firms if employees adhere to certain guidelines with respect to what they do and do not trade. He does not test whether employees follow these guidelines. The purpose of the two studies presented here is to develop an empirical understanding of the actual information-trading behavior of employees.

The first study, an analysis of 204 decisions about whether to trade information, provides a general description of information-trading patterns. The study demonstrates that, on average, employees attempt to trade information in the economic interests of their firms.

The second study provides a detailed analysis of the information-trading decisions of 39 employees. It both serves as a test of the validity of the general pattern found by the first study and provides a more detailed understanding of trading decisions of individual employees. It suggests that employees use heuristics to simplify the information-trading decision and that the complexity of these heuristics depends on the managerial information available to the employee.

Both studies concentrate on the U.S. specialty steel and steel mini-mill industry, a segment chosen because it is characterized by considerable non-radical technical advance. For example, the industry achieved a 70 percent reduction in the average tap-to-tap time from 1975 to 1985. (The tap-to-tap time is a parameter describing the efficiency of the melting process.) During this same period, average man-hours per ton fell by 47 percent (Barnett & Crandall, 1986: 57). This progress, however, is not due to radical technical change. The basics of the underlying technologies (electric arc furnace, continuous caster, rolling mill) remained

unchanged during those 10 years. Rather, continuous improvements of existing technology were key to the industry's progress (Barnett & Crandall, 1986). Consequently, information about small improvements, which is often transferred informally, has a significant impact on firm performance in this industry.

Methodology of First Study: Questionnaire Survey

A mail questionnaire was used to learn about employees' decisions whether to transfer information to colleagues in other firms and to test whether informal information transfers are part of information-trading relationships that benefit firms.

The questionnaire was sent to 477 technical managers, all of those listed under the 127 specialty steel or mini-mill companies appearing in the 1986 Directory of Iron and Steel Plants and identified by their job titles as directly responsible for technical aspects and not part to top management. Typical job titles are plant manager, superintendent of the rolling mill, superintendent of the meltshop, and chief engineer.

In the questionnaire, half of the employees surveyed were asked to think back to the last instance in the past year when someone from another steel firm had requested technical information and they had provided that information. The other half of the respondents were asked to think back to the last instance when they had been asked for information and had not provided it. Both situations were to be described in terms of the same variables, using primarily 7-point scales.

The idea behind this approach was to collect two samples, one consisting of cases in which employees are willing to transfer information; the other, of cases in which employees refuse to transfer information. Using these two samples, transfer

and no-transfer situations could be compared systematically, and the variables that help discriminate between transfer and no-transfer situations could be identified.

The variables used to characterize the specific information-transfer decision can be divided into two groups: variables describing the context of a transfer decision (e.g., characteristics of the information seeker and of the firm he is working for, attributes of the relationship between the information owner and the information seeker) and variables relating to the desired information itself. Most variables were derived from a theoretical model based on von Hippel's information-trading hypothesis. In addition, variables were included that some pilot-study interviewees had pointed out as important to their transfer decisions but that do not relate in an obvious way to the information-trading hypothesis (for more details, see Schrader, 1990).

The questionnaire was mailed to the 477 selected employees in August 1987. Twenty-nine of those could not be reached or had retired. Of the 448 employees reached, 297 returned the questionnaire. Three questionnaires had to be discarded, either because most questions were not answered or because the answers contained obvious inconsistencies. The remaining 294 questionnaires yielded a response rate of 65.6 percent (64.7 percent for version 1, transfer situation; 66.5 percent for version 2, no-transfer situation). One-hundred-three of the 127 firms included in the sample were represented by the returned questionnaires. To test whether the employees who received and returned version 1 of the questionnaire were significantly different from those who received and returned version 2, the two groups were compared in regard to demographic and firm-specific characteristics. No significant difference could be detected.

Not all respondents answered the part of the questionnaire referring to the employee's most recent information-transfer decision. Forty-four respondents could not answer this part because they had not been asked for information during the

year before the survey; 43 of the respondents who received a questionnaire that inquired about a rejection of an information request indicated that they had not rejected any requests; 3 of the employees who were asked to describe a transfer situation indicated that they had rejected all information inquiries by colleagues from other firms. Altogether the survey yielded 204 characterizations of information requests, of which 119 referred to transfer situations and 85 to no-transfer situations. (In some of the subsequent tables, the number of reported observations is smaller than expected due to missing data.)

Trading with Competitors

The exchange of information is clearly in the interest of the firms involved if they do not compete with each other. To supply a non-competitor with information does not create any disadvantage — provided the receiving firm does not give the information to another firm that is a competitor — and to receive information in return can be potentially of great benefit. To trade information with a competitor, however, can be disadvantageous if no special attention is paid to what to exchange and what to keep proprietary (Carter, 1989; Hamel et al., 1989; Schrader, 1991; von Hippel, 1987).

Consequently, the first question addressed by the survey was whether information trading occurs only between non-competing firms or also between competing firms. An indicator for the degree of competition between the two firms involved in an information exchanged was calculated (Schrader, 1991). This indicator, with a value range from 1 to 7, takes on a large value if the firms sell similar products to the same customer group.

Insert Figure 2 about here

In the majority of the cases, the firms involved in an information exchange do not compete directly (Figure 2). In nearly one-third (29.4 percent) of the cases, however, the firms are direct competitors. Is it in the firms' interests that employees exchange information with colleagues who are working for competing firms?

Consideration of Firms' Economic Interests in Trading Decisions

Frequently, rival firms have the possibility of benefiting from selective cooperation (Schrader, 1990: 154). That is, they cooperate in some fields while competing in others. Selective cooperation is possible whenever rival firms can identify areas in which they are not in a purely competitive relationship but in which cooperative behavior is mutually advantageous.

Von Hippel defines conditions under which trading information with a competitor creates a joint benefit. To trade information is economically advantageous as long the information offers "relatively little competitive advantage" (von Hippel, 1987: 298). In this context, competitive advantage is defined as "the extra increment of rent which the firm can expect to garner if it does not trade the unit of proprietary know-how" (von Hippel, 1987: 298).

Do employees trade information accordingly? To investigate this question, I compared the 119 descriptions of cases in which employees traded information with the 85 descriptions of cases in which they refused to trade. A discriminant analysis is used to test whether the two types of cases (trading and not trading) can be distinguished systematically by the circumstances of the trading decision. Seven factors serve as independent variables. These factors have been derived by factor

analysis of the 26 variables used to characterize that information content and the context of the information-transfer decision. Table 1 briefly characterizes the factors. (The factor loadings are provided in Schrader, 1991.)

Insert Table 1 about here

The resulting discriminant function classifies 73.2 percent of the cases correctly, i.e., the discriminant function correctly distinguishes in nearly three-quarter of the cases between situations in which employees are willing to trade information and those situations in which they refuse to do so. To be able to evaluate the relative importance of the factors used as independent variables, Table 2 reports standardized and normalized discriminant coefficients (Flury & Riedwyl, 1988; Klecka, 1980). The stability of the discriminant function was tested with a split-sample procedure. The results are stable.

Insert Table 2 about here

Table 2 suggests that employees attempt to consider the economic interests of their firms in their trading decisions. The personal relationship between employees is apparently of secondary importance. Employees take both benefits and costs of information trading into account. Benefits are caused through the reciprocal nature of information trading, while costs result primarily from giving up those advantages that are based on exclusive possession of information.

Benefiting through reciprocity. Information trading can be beneficial to the firms involved if valuable information is reciprocated. Consequently, as Carter (1989: 157) suggests and Table 2 demonstrates, employees "favor partners that

promise the most useful information in return." They trade with employees with considerable technical knowledge, thus increasing their chance of receiving valuable information in return. Note that the importance of the transferred information to the inquiring party apparently has a small positive influence on the trading decision as well. The more the receiving party is helped, the greater the obligation to return valuable information (Adams, 1965; Blau, 1964; Emerson, 1976).

Employees are aware of the reciprocal nature of information trading. Those surveyed were asked to indicate to what extent they expected their transfer decision to change the inquirer's willingness to provide information to them in the future. That is, they were asked the extent to which they expected their specific transfer decision to increase their chance of receiving information (or, if they had refused to provide information, the extent to which they expected the transfer to decrease their chance of receiving information). In 72 percent of the cases in which employees provided information to a colleague in another firm, they thought that their chance of receiving information from that employee in the future was improved. Those employees who transferred information that they considered important to the inquirer and the inquirer's firm[2] expected more often that this would considerably improve their chance of receiving information than did employees who transferred information they considered to be of low importance to the receiver (Table 3).

Insert Table 3 about here

Apparently, employees expect that an information receiver's cooperativeness (i.e., willingness to provide information) increases more if he or she receives information of high value than information of low value. Note, however, that this relationship does not always hold true. In nearly one-third of the cases in which the

transferred information was considered important, the surveyed employee did not expect this transfer to change the cooperativeness of the inquiring party. How can this be explained? These employees may have exchanged information extensively in the past; the transfers described by them may have reinforced but not changed existing relationships. This explanation is supported by the data. Relationships that have existed for an extended period of time are less affected by a single transfer decision than are newer relationships. The correlation between the expected change in the information receiver's willingness to provide information and the length of the relationship is r=-0.24, p<0.01. Relationships develop over time, becoming more and more independent of single transfer decisions.

Costs of providing information. The provision of information to another firm reduces the informational advantage of the providing firm relative to the receiving one. Under some circumstances this can be very costly, especially if the two firms are direct competitors and if the information provides an important competitive advantage. The information-providing firm gives up the additional rent that it was able to capture due to the informational advantage.

Under some circumstances, however, giving up an informational advantage is of no economic consequences. This is especially the case under any of three conditions. First, the information-providing firm and information-receiving one may not compete. If the firms are non-rivals, the information-providing firm will not experience any competitive backlash (Carter, 1989) because any informational advantage is without economic consequences.

Second, providing information to a rival firm creates no disadvantage, or only a relatively small one, if the information relates to areas in which the two firms do not compete with each other. Receiving such information, however, can be of great benefit. Take, for example, two firms A and B that compete primarily on product quality and not on product price. Assume firm A possesses information

that could help both firms to simplify the production process but not to improve product quality. Even if A provides this information to B, A still benefits from the simplification. In other words, the rent that A expects to draw from this information is largely unaffected by whether firm B also knows the information. Transferring the information creates few costs for A.[3] Firm B, however, might benefit greatly from receiving the information, creating an obligation to reciprocate information that could benefit A in turn. Thus both firms would gain from trading this type of information.

Third, a firm does not give up an important competitive advantage as long as the receiver could have acquired the same or similar information from another source as well. Often, proprietary know-how can be independently developed by any competing firm that needs it, given an appropriate expenditure of time and resources (Teece, 1986; von Hippel, 1987). In a survey of 650 high-level R&D managers representing 130 lines of business, most of the respondents indicated that other firms can duplicate typical unpatented process and product innovations within a reasonable time span, and at costs considerably less than that of the innovator (Levin, Klevorick, Nelson, & Winter, 1987: 809). In addition, similar know-how frequently can be obtained from other sources — for example, from suppliers or from other firms in the same industry. In these cases, the competitive advantage caused by an informational lead would probably be lost even if the firm had refused to transfer the information. Consequently, if the receiving firm could easily develop the same or similar know-how internally or if similar information is available to the receiving firm from other sources, transferring information reduces a firm's rent expectations only slightly.

Do employees consider these three factors — degree of competition between information-providing and -receiving firm, competitive value of information, and availability of alternative information sources — when deciding whether to trade

information? The discriminant analysis presented in Table 2 suggests that these variables strongly influence employees' trading decisions. Employees are less inclined to trade information if the trading partner works for a rival firm; they are more inclined if the information can be obtained from other sources; and they prefer to exchange information that does not relate to a dimension on which the firms involved compete. The respective discriminant coefficients are -0.42, 0.37, and 0.25. In addition, employees are less inclined to provide information if they consider this information to be of great importance to their firm.

Summary of the General Information-Trading Pattern

The 204 information-trading decisions investigated reveal patterns suggesting that employees in the surveyed industry exchange information in the interests of their firms — as they perceive it. They are more inclined to exchange information if they can expect to receive valuable information in return. They prefer not to trade if providing information would considerably impede their firm's competitive position. Overall, the observed information transfers appear to benefit the receiving firms but not to harm the providing ones, especially since they are likely to receive information in return. This pattern suggests that firms are able to mutually benefit from information trading.

It should be pointed out that these observations are based on average behavioral tendencies as observed through surveying managers from the mini-mill and specialty steel industry. The survey does not provide detailed information on the decision patterns of individual managers. It cannot be determined whether the observed average pattern emerges because every manager takes all the discussed variables into account or whether the pattern was created because some managers focus on one group of variables and other managers on another group. A scenario

experiment was carried out with 39 managers from the same industry in order to answer this question and to test the validity of the derived results.

REDUCING THE COMPLEXITY OF INFORMATION TRADING DECISIONS

Informal information trading is connected with rapid decision making, decision making under time pressure. In general, a manager who is asked for information decides instantaneously whether to provide it. In such situations, heuristics are employed to reduce the complexity of the decision process (Nisbett & Ross, 1980; Tversky & Kahneman, 1974). Exploratory interviews with employees in the steel industry suggest that employees reduce the complexity of information-trading decision by considering only a reduced set of variables (Schrader, 1987).

The scenario experiment presented here investigates systematically whether employees differ in regard to the variables relevant to their information-trading behavior. The objective is to develop a more detailed picture of the information-trading decisions of individual employees. For this purpose, selected employees were confronted with a number of hypothetical requests for information. The employees had to decide for each case whether they would provide the requested information under the circumstances described. The analysis of these decisions, first, confirms the results of the previous questionnaire survey and, second, indicates three distinct decision patterns. Some employees decide based solely on the content and value of the information; other employees used the degree of competition between the involved firms as the decisive decision criteria; and, again, other employees exhibit more complex decision patterns by taking several variables into account.

Methodology of Second Study: Scenario Experiment

A scenario experiment with 41 managers from steel companies was used to gain a detailed understanding of individuals' decision-making patterns. The managers were asked to respond to different hypothetical information requests by making the appropriate transfer decisions. For this experiment, each participant received a set of 16 index cards. Every card details a situation in which a colleague from another firm calls up and asks for some specific technical information. These scenarios vary systematically along 5 of the 7 factors used in the previously discussed discriminant analysis.[4]

The factors included in the experiment are: importance of information to deciding party, importance to inquiring party, degree of competition, strength of relationship/friendship, and technological knowledge of inquirer and inquiring firm. The factor "availability of alternative information sources" was not included even though it is apparently important for the transfer decision; it turned out to be extremely difficult to manipulate this factor systematically and still keep the scenarios realistic.

The 16 hypothetical situations were formulated in close cooperation with three managers who had attended past meetings of the Plant Operations Division of the Steel Bar Mill Association, but who did not attend the meeting at which the experiment was conducted. A specific scenario was considered adequate when all three managers agreed on the value of the five factors depicted by the scenario.

All 41 attendees of the 1987 fall meeting of the Plant Operations Division participated in the experiment. The sample differs in three respects from the one used for the questionnaire survey: first, some attendees were employees of integrated steel companies; second, a few employees belonged to top management; third, all participants worked in plants with bar mill operations. The answers of two

managers showed obvious inconsistencies and had to be discarded. The transfer decisions of the remaining 39 managers constitute the basis of the following analysis.

The subjects were asked to perform three tasks: first, to decide for each scenario whether or not they would provide the desired information; second, to rank in order all scenarios according to the probability with which they would transfer the desired information; third, to mark this probability on a scale from 1 to 100 for each scenario. The third task, which enabled managers to express the intensity of their preferences, was included because in the pre-test subjects had perceived a sequential ranking as not sufficient for capturing reality.

Conjoint analysis was used to analyze the data. The conjoint analysis estimates, for each manager, the importance of the situational factors as described by the scenarios for his or her transfer decision. This importance is reflected in the so-called "part worths."[5] In other words, for every manager the conjoint analysis calculates the part worths of the five experimental factors that best describe that individual's preferences in regard to information trading.

Results

The experiment offers strong support for the conclusions drawn from the questionnaire survey. In addition, the experiment reveals substantial variance in how managers decide whether or not to transfer requested information. Three distinct decision patterns can be detected: value-oriented decision patterns, competition-oriented patterns, and complex patterns.

Confirmation of the general trading pattern. The experiment helps to determine for each manager how his or her transfer decisions are influenced by each of the five experimental variables. As just explained, the direction and magnitude

of the influence are reflected in the part worths. A comparison of the average part worth (experiment) for each variable with its standardized discriminant coefficient (questionnaire survey) indicates an obvious correspondence between the findings of the questionnaire survey and of the card experiment (Table 4). The results of the two research methods correlate with $r=0.95$; $p<0.02$. Only the technological knowledge of the inquiring party is an exception. The questionnaire survey leads to the conclusion that this factor is important, whereas the experiment suggests that, on average, it has no impact. One explanation for this apparent contradiction might be that the description used to operationalize this variable in the experiment broadly characterizes the technical know-how available to the inquirer. Perhaps the description was too general to influence a trading decision, making it difficult for the subjects to deduce whether their informational needs are met.

Insert Table 4 about here

The strong correspondence between the findings of the questionnaire survey and of the card experiment is even more remarkable if one takes into account that the results are drawn from different samples, build on different research methods, and refer to different research objects (actual past decisions in the questionnaire survey and hypothetical decisions in the card experiment). This similarity, which can be noted despite different research approaches, offers definite evidence for the validity of the results.

Variations in decision patterns. Employees differ strongly in their information-trading behavior, as indicated by the large standard deviation of the part worths. For example, the variable "importance of information to deciding party" has a factual range of -1 to 0 and a standard deviation of 0.41 (Table 5).

Insert Table 5 about here

In order to reduce this variance, the managers were sorted into groups using the KMeans-algorithm, a partitioning cluster method that maximizes the ratio of between-cluster to within-cluster variation. Using this algorithm leads to three clusters, the largest possible number under the condition that every cluster contains more than one element. The extracted clusters are stable with regard to the cluster algorithm used. Basically, the same three clusters emerge by using different clustering algorithms (complete linkage or average linkage).

Each of the three clusters contains a group of managers with quite similar preferences in regard to information trading. (Clustering the managers into three groups reduces the highest standard deviation of the part worth for any factor from 0.41 to 0.17.) The three types can be characterized as *value-oriented*, *competition-oriented*, and *complex* decision makers (Table 6).

Insert Table 6 about here

Value-oriented managers base their transfer decisions only on the importance of the requested information to their firms, independent of whether the value of the information would be affected by transferring it to the inquirer. Information of high value to the firm is not transferred, even if the inquirer is not a competitor, whereas information of low value is always transferred.

Competition-oriented managers also organize their decisions around one variable. Their sole focus, however, is the degree of competition between their

firms and the information inquirer's firm. Competition-oriented managers provide any kind of information as long as the inquirer does not work for a direct competitor. If the inquirer works for a competitor, no information is transferred.

Complex decision makers, on the other hand, take several variables into account when making trading decisions. They consider, for example, whether the information is of high value, whether the inquirer works with a competitor, and whether they can expect to receive valuable information in return.

These different approaches to making information-trading decisions might reflect how managers perceive the relationship among technology, competition, and firm performance, i.e., the mental models managers are using when trading information. Managers who take only the degree of competition into account are likely to employ a different mental model from those whose primary consideration is the value of the information. Mintzberg (1976: 54) describes mental models as follows: "In effect, managers (like everyone else) use their information to build mental 'models' of their world, which are implicit synthesized apprehensions of how their organizations and environments function. Then, whenever an action is contemplated, the manager can simulate the outcome using his implicit model."

It is interesting to note that a larger proportion of the investigated top managers (56%) than of the middle-level managers (43%) uses a complex decision-making mode. This might suggest a link between managers' hierarchical rank and the complexity of their mental models. This is to be expected since quantity and quality of information available influence the complexity and appropriateness of mental models (Frey, 1981) and, at least in the case of business organizations, the available information is likely to depend on the hierarchical rank. Given a sample size of only 39 managers, the reported difference is not statistically significant. It does, however, provide interesting suggestions for future research and for how to influence employees' information-trading behavior.

CONCLUSION

This chapter has presented empirical evidence on informal information trading in the U.S. specialty steel and steel mini-mill industry. Information is exchanged informally between firms, including direct competitors. Employees who trade information apparently orient their trading decisions around the economic interests of their firms. Employees are less inclined to provide information if doing so is likely to considerably hurt their firm's ability to capture economic rents from the information. They are more willing to provide information if they can expect to receive valuable information in return. Factors like friendship or duration of the relationship with the inquirer appear to be of secondary importance for the decision whether to provide a specific unit of information. It also has been shown that employees simplify the complexity of trading decisions by considering only a selected set of variables, especially the importance of the information to the employee's firm and the degree of competition between the involved firms.

One important limitation of this study must be pointed out. All empirical data are drawn from one industry, the U.S. specialty steel and steel mini-mill industry. It remains untested whether the close alignment of managers' and firms' interests that apparently exists in the steel industry also can be found in other industries. Different information-trading patterns might be expected in those industries characterized by high job mobility and difficulties linking employees' contributions to the performance of their firms (Rogers, 1982). A pilot study in the aerospace industry, however, suggests that, even in such an industry, information-trading patterns similar to those found in the steel industry are present (Gavrilis, 1989).

Informal information trading provides a managerial challenge. Management is called upon to implement organizational settings that guide information-trading

behavior in the desired direction while at the same time preserving the informality of the process.

The informality of the trading process creates considerable control problems. Even if each individual employee intends to act in the firm's interests, the sum of the transactions might turn out to be disadvantageous (Hamel et al., 1989). Therefore it is necessary for firms to develop an overall picture of their net of information-trading relationships.

Several firms in the U.S. oil-exploration industry have implemented an organizational solution to this problem (Schrader & von Hippel, forthcoming). Oil-exploration companies employ individuals, so-called oil-scouts, whose task is to informally trade information, especially well-log data, with oil-scouts working for other exploration firms. In some cases, data are exchanged simultaneously for other data, while in other instances data are provided for an understanding that the favor will be returned later. The scout system provides several advantages. First, since all transfers of well-logs are either done by oil-scouts or reported to them, firms can easily gain a firm wide overview of their trading relationships. Second, the concentration of the trading function in a few individuals generates advantages due to specialization. Oil-scouts are likely to be better traders, with a wider network of contacts than employees for whom information trading is only one of many tasks. Third, concentrating the trading function helps to established control procedures to assure that information is not inadvertently traded against the interests of the firm. Some firms, for example, identify those well-logs that can be traded only with approval by senior managers. Other firms brief their scouts regularly on their business strategies and strategies for relating information. Note, however, that concentrating the information-trading function in a few individuals is not always an appropriate organizational solution. Allen (1984), for example, demonstrates

that only under specific circumstances is it advantageous to channel information transfers through a few key individuals.

Many circumstances are conceivable under which an information exchange is in the economic interest of the involved firms, yet under which detailed formal transfer agreements are ruled out because they are too expensive. Most formal information-transfer agreements are complex legal constructs that attempt to address problems stemming from opportunistic behavior and asymmetric information. High transaction costs are one reason why only a few firms use some formalized technology transfer process such as licensing and why only a small fraction of available information is transferred this way (Reid & Reid, 1987).

Unlike formal information transfer, informal information trading entails limited transaction costs. In particular, contracting costs and control and enforcement costs are insignificant in comparison to formal agreements: no lengthy negotiations are required, and no costly legal institutions are necessary to monitor the information exchange. These simplifications are made possible at the expense of legal mechanisms that could be used to force the trading partner into fulfilling its obligations. Fortunately, other, less costly control mechanisms do exist. For example, news about uncooperative behavior appears to travel fast within the surveyed industry. Thus, by not cooperating in one relationship, a player puts several relationships in jeopardy — a strong mechanism for enforcing cooperation.

Information leading to small, incremental improvements is especially likely to fall into the category of information not suitable for formal transfer agreements. Firms that do not use informal information trading to acquire this kind of information are sacrificing an important information source. Several empirical investigations have shown that incremental improvements can be very important to a firm's economic success (Enos, 1962; Hollander, 1965).

Even if a formal contract governs the exchange of technology, informal information trading is likely to occur. In joint ventures, for example, employees have to decide daily which specifics to contribute and which to keep secret — even if the joint venture agreement prescribes each firm's contribution in general terms. Thus, understanding information trading might also lead to a better understanding of the workings of other, more formalized kinds of inter-firm cooperation.

Informal information trading provides firms with the possibility of cooperation without explicitly governing specific transactions by formal contracts. This informal cooperation mechanism supplements the toolbox of formal inter-firm alliances.

FOOTNOTES

[1] This chapter builds partly on results that were published previously in Schrader, 1990 and Schrader, 1991.

[2] Information is classified as being of low importance to the receiving party if the value of the relating factor is less than the median. A value equal to or above the median serves as an indicator of high importance.

[3] Transferring this information creates costs for firm A only if the resulting costs savings induce B to finance measures that affect A adversely and that would not have been financed otherwise.

[4] Five is the maximum number of dimensions that can be included in a fractional factorial design (Addelman, 1962), given the following three conditions: the number of cards should not exceed 16, each factor can take on two possible values (high and low), and the experiment should be able to measure all two-way interactions.

[5] Since each variable has only two levels, it is not necessary to estimate both part worths and importance weights.

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TABLE 1

Factors Describing the Situational Setting of Information-Trading Decisions

Factor	Content
Context of Trading Decision	
1 Strength of relationship/friendship	Describes aspects of the relationship between the information owner and the person inquiring for information; takes on a high value if the two employees have exchanged information in the past and if a close personal relationship exists between them.
2 Intensity of competition between involved firms	Combination of two factors. One factor describes whether the two firms sell their products in same regionally defined markets and to same customer groups. The other characterizes extent to which firms produce similar products and employ comparable production technology. Takes on high value if firms are direct rivals.
3 Technological knowledge of inquirer and inquiring firm	Takes on high value if the information owner perceives inquirer's firm as one of the technological leaders in the industry and inquirer as having large degree of technological expertise.
Characteristics of Requested Information	
1 Importance of information to deciding party	Describes information owner's perception of the importance of the requested information to himself or herself and to his or her firm.
2 Importance of information to inquiring party	Describes information owner's perception of the importance of the requested information to the inquirer personally and to his or her firm.
3 Degree to which information relates to domains of low competitive importance	Indicates the extent to which requested information relates to domains that might be important for a firm's overall performance, but which are not domains in which the firms compete fiercely with each other.
4 Availability of alternative information sources	Reflects whether the information owner thinks that other alternatives are open to the inquirer to cover his or her informational needs. Alternative sources include developing a similar information internally or acquiring comparable information from other external sources.

TABLE 2

The Importance of Different Variables for Information-Trading Decisions
(Discriminant analysis of situations in which employees have provided
information and those in which they refused to do so)

Independent variables	Standardized and normalized discriminant coefficients		
	Full sample (n=149)	Subsample 1 (n=71)	Subsample 2 (n=78)
Technological knowledge of inquirer and inquiring firm	+ 0.54	+ 0.42	+ 0.62
Importance of information to deciding firm	- 0.42	- 0.40	- 0.43
Intensity of competition between the firms involved	- 0.42	- 0.48	- 0.38
Availability of alternative information sources	+ 0.37	+ 0.35	+ 0.37
Strength of relationship/friendship	+ 0.36	+ 0.40	+ 0.31
Degree to which information relates to domains of low competitive importance	+ 0.25	+ 0.30	+ 0.22
Importance of information to inquiring party	+ 0.17	+ 0.25	+ 0.09
Canonical correlation Significance	r=0.50 p<0.001	r=0.58 p<0.001	r=0.48 p<0.01
Kendal coefficient of concordance Friedman test statistic	0.97 17,4; p<0.01		

Interpretation: A positive discriminant coefficient indicates that requested information is more likely to be provided if the variable takes on a large positive value.

Source: Schrader, 1990.

TABLE 3

Importance of Transferred Information and Expected Change in Inquirer's
Willingness to Provide Information
(Percentage of cases per group)

Importance of transferred information to inquiring party	Expected change in inquirer's willingness to provide information				
	No change			Much more likely to provide information	
	4	5	6	7	Σ
• Low	31.0%	20.7%	27.6%	20.7%	100% (n=58)
• High	25.4%	5.1%	39.0%	30.5%	100% (n=59)

Chi-square = 8.121; p<0.05

Note: The data are from the 119 descriptions of transfer situations. Two of these cases had to be eliminated due to missing values.

Source: Schrader, 1991.

TABLE 4

Comparison of the Questionnaire Survey and Card Experiment Results

	Standardized discriminant coefficient (Questionnaire survey)	Average part worth (Experiment)
Importance of information to deciding party	-0.42	-0.43
Intensity of competition between the firms involved	-0.42	-0.31
Strength of relationship/friendship	+0.36	+0.10
Importance of information to inquiring party	+0.17	+0.05
Technological knowledge of inquirer and inquiring firm	+0.54	+0.01

Source: Schrader, 1990.

TABLE 5

Inter-Employee Variation of Information-Trading Decision Patterns
(Distribution of part worths)

	Mean	Standard deviation	Minimum	Maximum
Importance of information to deciding party	-0.25	0.41	-0.99	0.00
Intensity of competition between firms involved	-0.25	0.34	-0.99	0.00
Strength of relationship/friendship	+0.20	0.15	-0.14	0.50
Importance of information to inquiring party	+0.08	0.13	-0.20	0.49
Technological knowledge of inquirer and inquiring firm	+0.22	0.15	-0.43	0.49

Source: Schrader, 1990.

TABLE 6
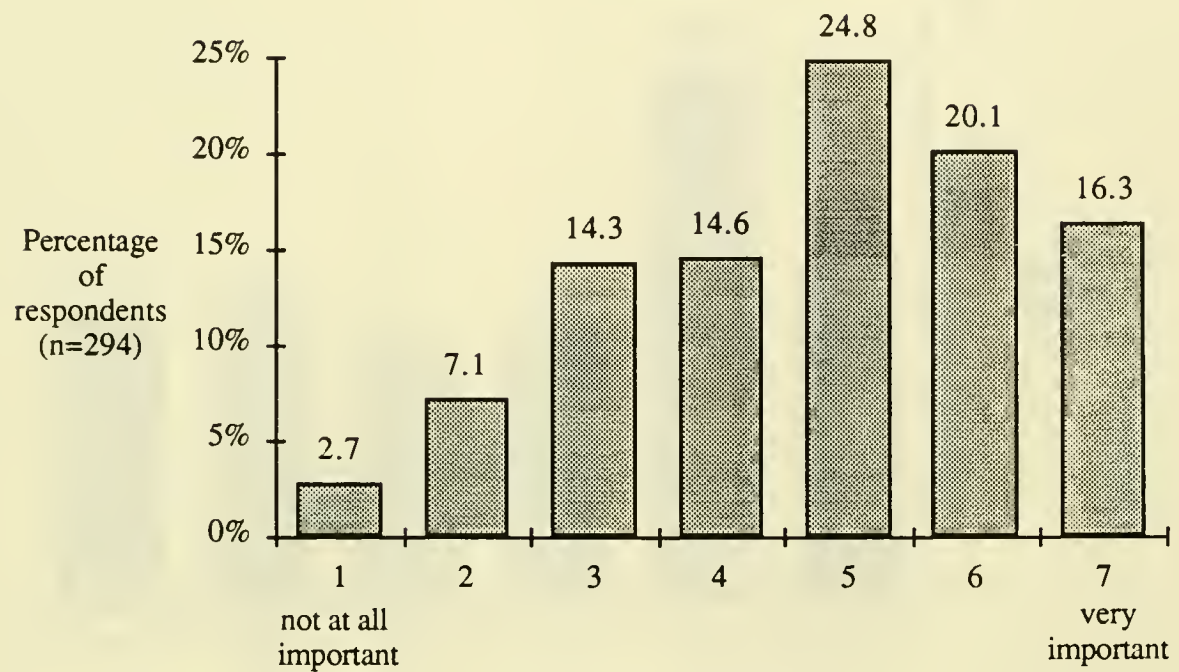
Three Types of Information-Trading Decision Patterns
(Distribution of part-worths per cluster of subjects)

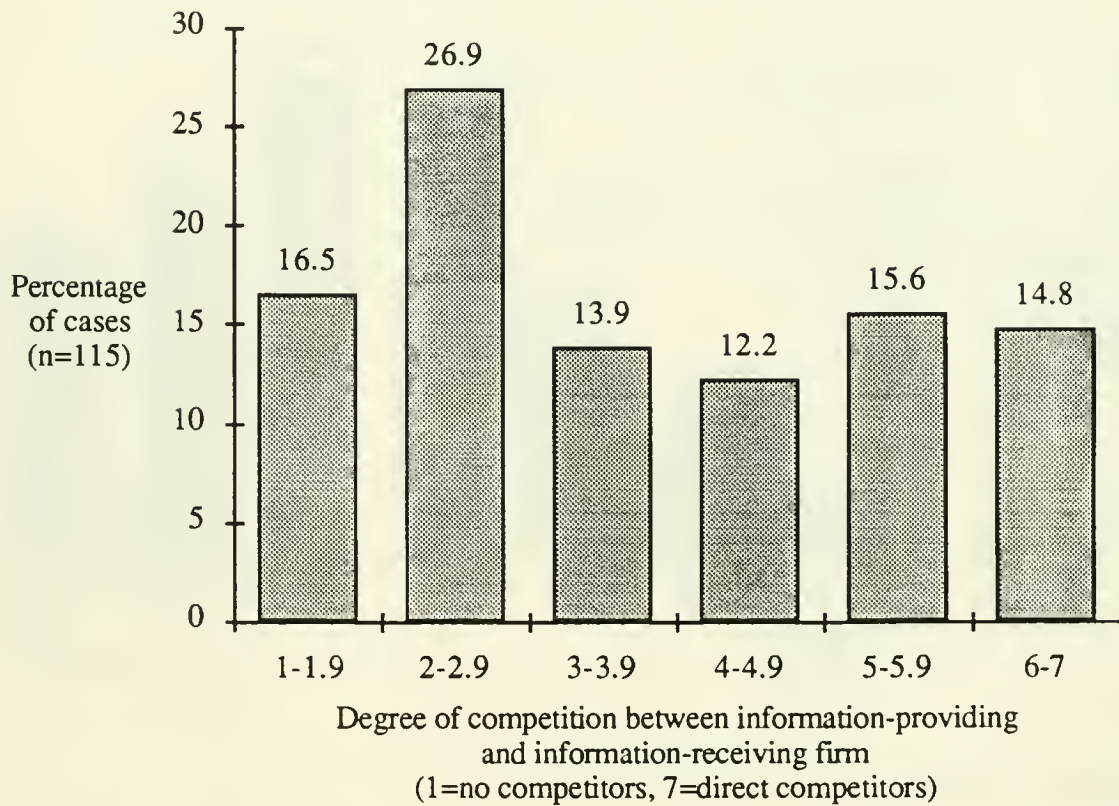|	Cluster 1: value-oriented (n=13)		Cluster 2: competition-oriented (n=7)		Cluster 3: complex (n=19)	
	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation
Importance of information to deciding party	-0.99	0.01	-0.01	0.00	-0.21	0.12
Intensity of competition between involved firms	-0.01	0.00	-0.91	0.17	-0.29	0.13
Strength of relationship/ friendship	0.00	0.01	0.00	0.00	0.19	0.16
Importance of information to inquiring party	0.00	0.00	0.00	0.00	0.10	0.17
Technological knowledge of inquirer and inquiring firm	-0.00	0.00	0.07	0.17	-0.02	0.17

Source: Schrader, 1990.

FIGURE 1

Importance of Informal Information Transfer Between Firms for Respondents

Source: Schrader, 1991.

FIGURE 2

Information Trading Between Rival and Non-Rival Firms

Percentage of cases (n=115)

Degree of competition between information-providing
and information-receiving firm
(1=no competitors, 7=direct competitors)